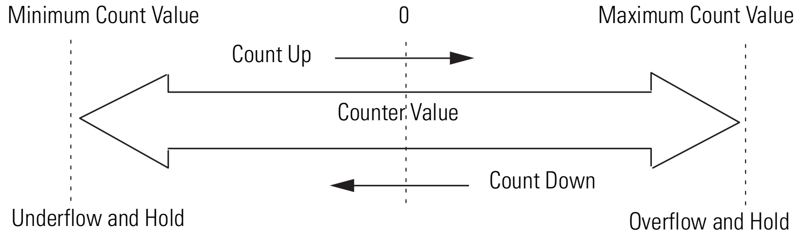
Counter Types

Each of the four possible counters can be configured to stop counting and set a flag at its limits (linear counter) or to roll over and set a flag at its limits (ring counter). A counter's limits are programmed by the Ctr*n*MaxCount and Ctr*n*MinCount words in the Module Configuration Array. Both types are described below.

Linear Counter

The figure below describes linear counter operation. In linear operation, the current count (Ctr[*n*].CurrentCount) value remains between, or equal to, the user-programmed minimum count (Ctr*n*MinCount) and maximum count (Ctr*n*MaxCount) values. If the Ctr[*n*].CurrentCount value would go above (>) or below (<) these values, the counter stops counting, and an overflow/underflow bit is set. The overflow/underflow bits can be reset using the Ctr*n*ResetCounterOverflow and Ctr*n*ResetCounterUnderflow bits.

Figure 2.6 Linear Counter Diagram

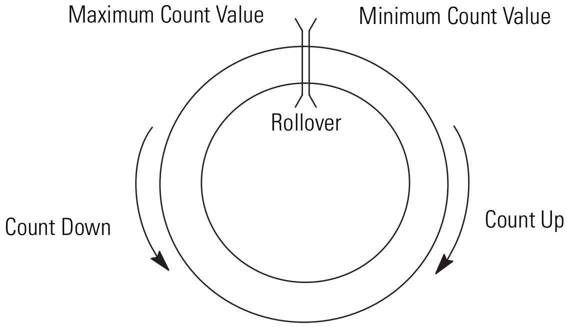


Pulses are not accumulated in an overflow/underflow state. The counter begins counting again when pulses are applied in the proper direction. For example, if you exceed the maximum by 1,000 counts, you do not need to apply 1,000 counts in the opposite direction before the counter begins counting down. The first pulse in the opposite direction decrements the counter.

Ring Counter

Figure 2.7 demonstrates ring counter operation. In ring counter operation, the current count (Ctr[*n*].CurrentCount) value changes between user-programmable minimum count (Ctr*n*MinCount) and maximum count (Ctr*n*MaxCount) values. If, when counting up, the counter reaches the Ctr*n*MaxCount value, it rolls over to the Ctr*n*MinCount value upon receiving the next count and sets the overflow bit. If, when counting down, the counter reaches the Ctr*n*MinCount value, it rolls under to the Ctr*n*MaxCount value upon receiving the next count and sets the underflow bit. These bits can be reset using the Ctr*n*ResetCounterOverflow and Ctr*n*ResetCounterUnderflow bits.

Figure 2.7 Ring Counter Diagram



Modifying Count Value

The count value (Ctr[*n*].CurrentCount) can be stored, reset, or preset using the Z input, CtrReset bit in the Configuration Array, control bits in the Output Array, or written over using a Direct Write command.

Table 2.7 Available Z Functions

Setting	For function
Store[1]	on rising edge of Z, store count in the Stored Count input word
Hold	while Z = 1, hold counter at its current value
Preset/Reset	on rising edge of Z, preset the count value to the value in the preset word

[1] If both a store and preset function are configured, the stored count is captured before the preset operation takes place.

IMPORTANT Because only the Z inputs are used for external gating and presetting, these functions are not available for Counters 2 and 3, which do not have Z inputs. All options are always available for Counters 0 and 1, regardless of input operational mode.

Counter Enable/Disable

The counter may be enabled or disabled using the Ctr*n*En control bit. Be aware that disabling the counter does not inhibit any current count loading functions (e.g. preset or direct write) or any Z function.

Z Input Functions

Store

The Z input can be used to capture the current count value even when the counter is counting at full 1 MHz speed.

Gate

The Z inputs can be used to gate (hold) the counter at its current value regardless of incoming A or B inputs. A gating function is typically one that allows pulses to reach the counter (gate open) or not (gate closed).

Z Preset

Preset can be programmed to occur based on the actions of the Z input signal.

Inhibit and Invert

The Z input signals may be inverted and/or inhibited, depending on the user configuration of the Ctr*n*ZInvert and Ctr*n*ZInhibit output control bits. If the signal is inhibited, the invert bit *is* the Z signal for the actions described above.

For an explanation of those bits, see Z Inv - Z Invert (CtrnZInvert) on page 4-25 and Z Inh - Z Inhibit (CtrnZInhibit) on page 4-25.

Direct Write

You can arbitrarily change the current count value (Ctr[*n*].CurrentCount) to the direct write control value (Range12To15[*n*].HiLimOrDirWr). This ability applies to ranges 12 through 15. The direct write value takes effect when the Load Direct Write bit (Range12To15[*n*].LoadDirectWrite) transitions from 0 to 1.

If you attempt to preset and load direct write to a counter at the same time, only the preset (Ctr*n*Preset) will take effect.

Preset/Reset

Preset sets the counter to a zero or non-zero value you define. Reset the counter by setting this value (Ctr*n*Preset) to zero.

Counter Reset

The CtrReset bit in the Configuration Array, when set, causes the following to occur when the system transitions to Run or the Inhibit Module bit transitions to 0:

- All counters are disabled and reset to zero.
- The Output Array is reset to default values until the ModConfig bit is set (1). The default value for the Output Array is all zeros.
- The Input Array counter Status Flags (Overflow, Underflow, RisingEdgeZ, RateValid, PresetWarning) are reset.
- The Input Array counter values (Current Count[1], StoredCount, CurrentRate and PulseInterval) are also reset to zero.
- All counts are lost and all outputs are turned off.

IMPORTANT For the most predictable results, you may want to clear the output image of the processor BEFORE performing a counter reset (CtrReset) to the 1769-HSC module.

This is because CtrReset does not change the processor's output image. CtrReset sets the 1769-HSC module's Output Array to all zero's. If any bit is set to 1 in the processor's output image, when sent to the module, it will be seen as a state transition and be acted upon.

Soft Preset

Preset can be programmed to occur by setting the appropriate output control bits via your control program. Setting the Ctr*n*SoftPreset bit in the Output Array causes the counter to be preset, changing the count to the value in Ctr*n*Preset.

[1] If zero is outside the MinCount and MaxCount limits set in the Configuration Array, then the Preset value is loaded into CurrentCount instead of zero. This also causes the PresetWarning bit to be set, which, in turn, sets the GenError bit.

Z Preset

Preset can be programmed to occur based on the actions of the Z input signal.

Autopreset

If the module is configured such that Ctr*n*MaxCount < Ctr[*n*].CurrentCount or Ctr*n*MinCount > Ctr[*n*].CurrentCount, then the module will automatically change Ctr[*n*].CurrentCount to the Ctr*n*Preset value and set the Ctr*n*PresetWarning bit.